Knowles®

TB14

TECHNICAL BULLETIN

THE EFFECT OF ACOUSTIC DAMPING PLUGS ON RECEIVER RESPONSE

The purpose of this report is to discuss applications of the Knowles line of acoustic damping plugs and their use in altering receiver frequency response. The basic miniature magnetic receiver tested with a 10mm x 1mm I.D. transmission tube into a 2cc cavity has a smooth response characteristic with two or three small resonances present. The number present depends on the specific model series. Figures 1A, B, and C illustrate frequency response curves for models in the ED, EF and EH series respectively.

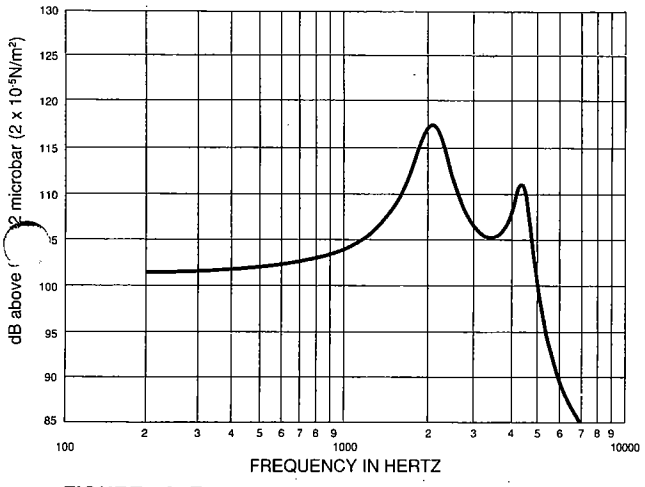

FIGURE 1A. Frequency response of ED receiver.

Receivers are used in this mode in many in-the-ear and in-the-canal hearing aids or in applications as an insert-type receiver. Behind-the-ear hearing aids use a stepped diameter transmission tube to conduct the sound from the receiver to the ear. A custom-made earmould is used to connect the end of the transmission tube to the ear opening. This transmission tube substantially changes the receiver response characteristic by introducing additional peaks and valleys. (Refer to Knowles Electronics Technical Bulletin TB-6, "Effects of Acoustical Termination Upon Receiver Response".)

A similar change occurs in the microphone response characteristic. (Refer to Knowles Electronics Technical Bulletin TB-3, "Effects of Sound Inlet Variations on Microphone Response".) The length and the diameter of acoustic transmission tubes often are selected to produce controlled response effects in hearing aids and in other electro-acoustic equipment.

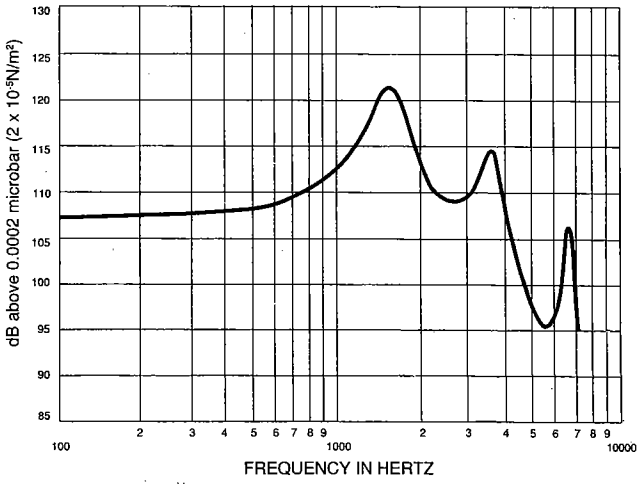

FIGURE 1B. Frequency response of EF receiver.

The resonances of a receiver using a transmission tube can be altered by use of acoustic damping plugs in the transmission tube. There are presently BF dampers available from 300 to 4700 ohms in a variety of diameters to match commonly used hearing aid tubing. For a given receiver with transmission tube and termination, the damping system parameters include the specific model number damping plug(s), the quantity of plugs used, and the exact location of each plug in the tube. Figure 2A shows a receiver with a BTE acoustic transmission tube terminating into a 2cc coupler and damping plugs in positions A and B, while figure 2B represents an ITE/ITC acoustic load.

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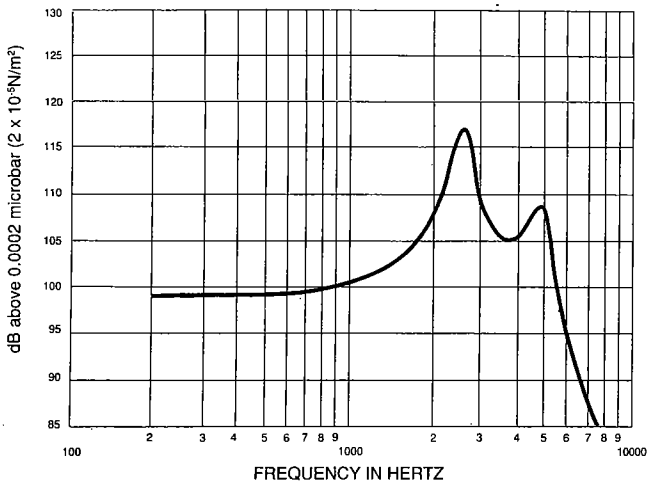

FIGURE 1C. Frequency response of EH receiver.

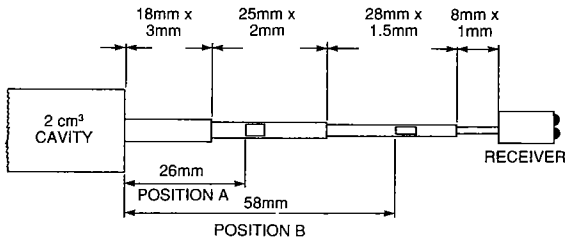

FIGURE 2A.

If other size acoustic transmission tubes had been used in these experiments, the resulting response characteristic would have been different. For example, while the HA-2 coupler has a 3mm I.D. x 18mm long tubing, many earmoulds use different internal tubing sizes and therefore would be expected to produce different response in application.

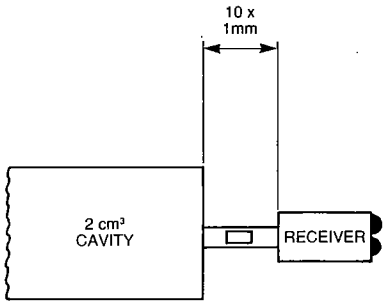

FIGURE 2B.

Figures 3A, 3B and 3C show the effect of adding damping plugs to the transmission tube of an acoustic load driven by an ED receiver, an EF receiver, and an EH receiver, respectively. Figures 4 and 5 show the effects of damping plugs on CI and BK receivers using a behind-the-ear acoustic load. For the BK and CI receivers, the acoustic damping was varied from a condition of no damping, to one damping plug at each of two specific locations (Position A or Position B), and then with a pair of plugs with one each at Position A and Position B). These curves illustrate that receiver performance can be made essentially free from resonances when the application requires that type of performance, but at a cost of lower average sensitivity.

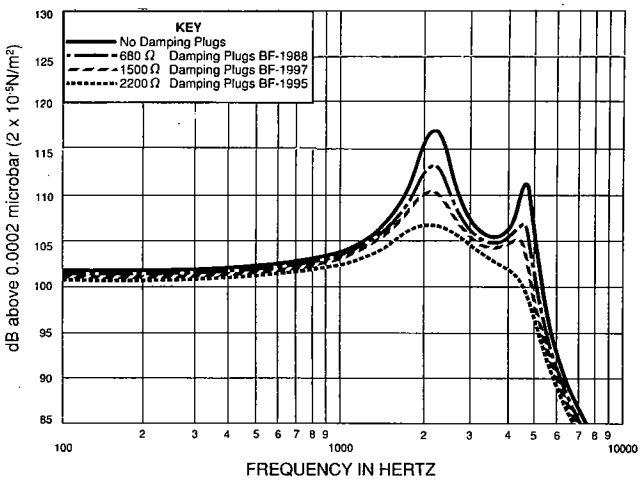

FIGURE 3A. Frequency response of ED receiver.

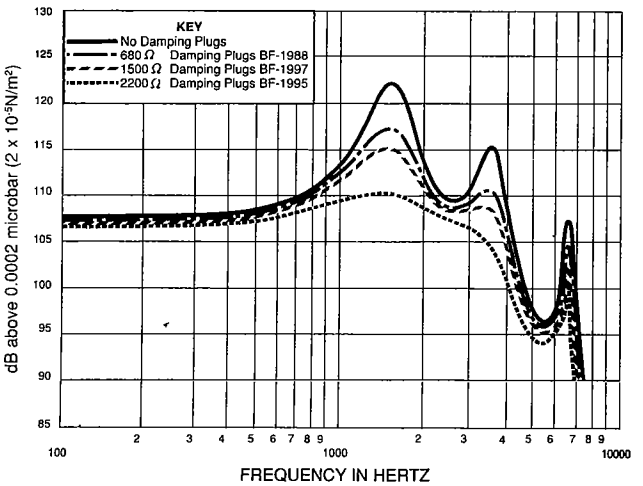

FIGURE 3B. Freqency response of EF receiver.

Figure 6 shows the effect of moving a single BF plug in 5mm steps from Position A to Position B. Notice that the position of the damping plug in the tube can have quite a critical effect upon response at some frequencies.

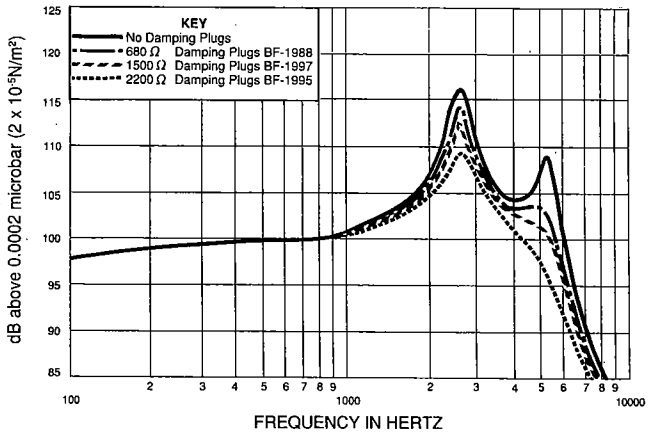

FIGURE 3C. Frequency response of EH receiver.

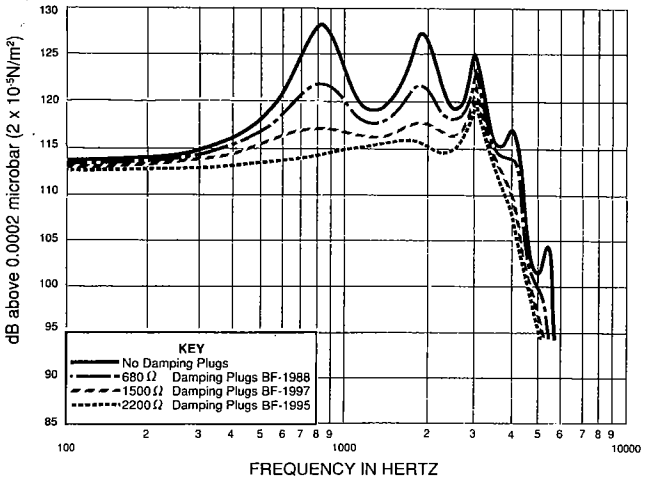

FIGURE 4A. Frequency response of CI receiver with Damping Plug in position A.

These curves were made on typical receivers from current production, and are intended to show the types of performance control which can be achieved when using BF damping plugs. No attempt was made to determine the nature of the receiver-to-receiver variation with a given acoustic load, although this effect is expected to be small. It should also be pointed out that the effect of electrical drive on response characteristic is important, especially with wide band receivers. (Refer to Knowles Electronics Technical Bulletin TB-7, "Effect of Source Impedance on Receiver Response".)

One practical method of applying the BF damping plugs to a specific situation would be to use the patients actual earmould with an HA-1 coupler and external tubing connected to the hearing aid. This will give the application engineer, designer, or hearing aid technician a method of optimizing the response.

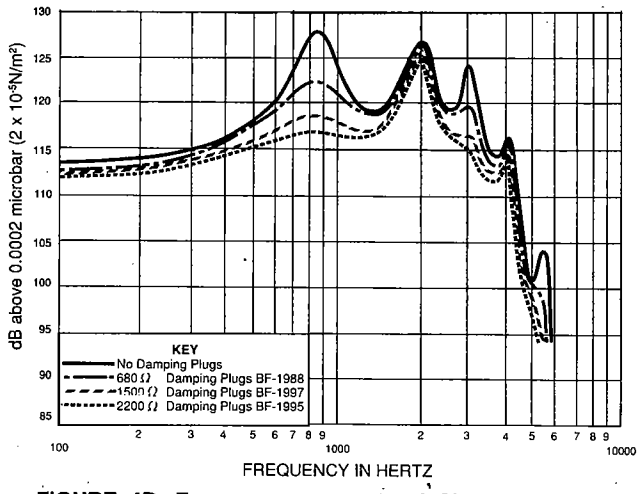

FIGURE 4B. Frequency response of CI receiver with Damping Plug in position B.

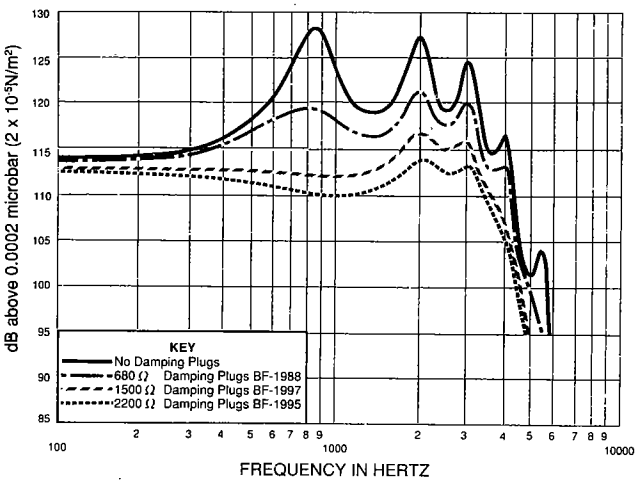

FIGURE 4C. Frequency response of CI receiver, Damping Plug in positions A & B.

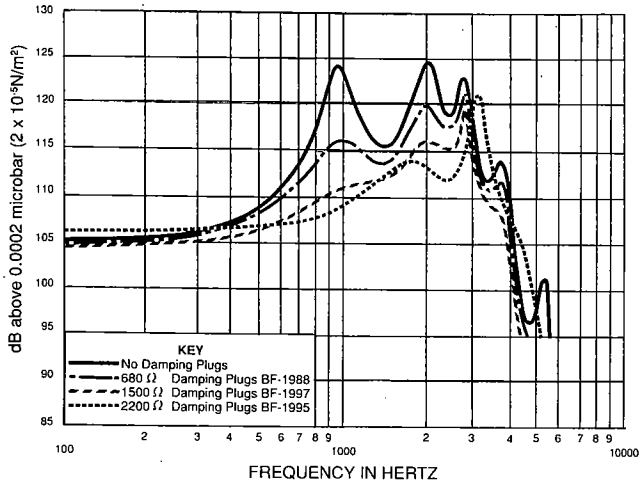

FIGURE 5A. Frequency response of BK receiver with Damping Plug in position A.

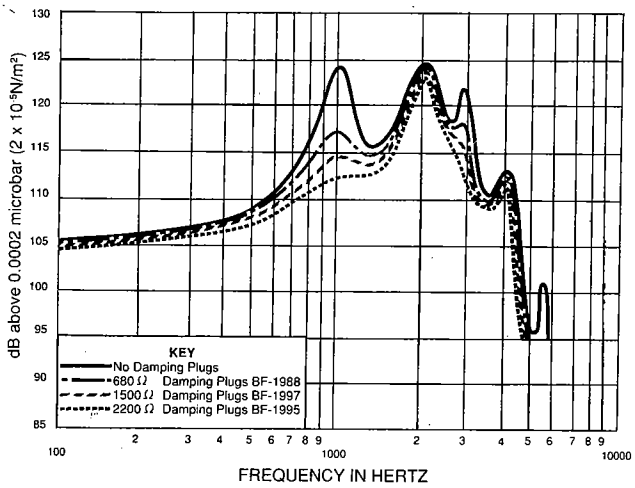

FIGURE 5B. Frequency response of BK receiver with Damping Plug in position B.

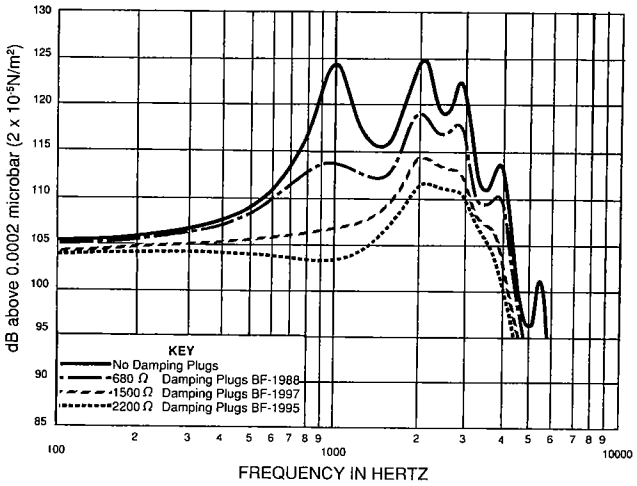

FIGURE 5C. Frequency response of BK receiver, Damping Plug in positions A & B.

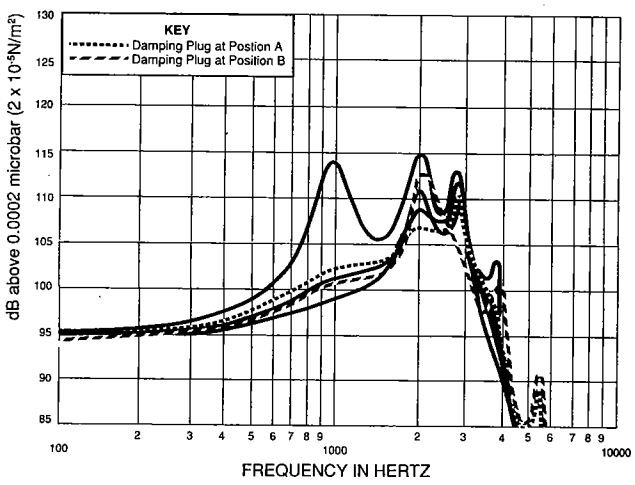

FIGURE 6. Frequency response of BK receiver, the Damping Plug being moved in 5mm steps from position A to position B.

REFERENCES:

Killion, Mead C., *Earmould Option For Wideband Hearing Aids.* Journal of Speech and Hearing Disorders, Feb 1981 10-20.

Killion, Mead C., *Smooth Insertion Gain Coupling for the EF-Series Receiver in OTE Applications.* Available as IRPI Report 10590-1 from Knowles Electronics Inc.

Killion Mead C., Murphy W. J., *Smoothing the ITE Response: The BF-1743 Damped Coupling Assembly.* Available as IRPI Report 10559-2 from Knowles Electronics Inc.

Knowles Electronics Inc. Acoustic Damping System Data Sheet.